DRAFT REPORT

LOS CERRITOS WETLANDS CONCEPTUAL RESTORATION PLAN

Prepared for:

California Earth Corps
4927 Minturn Avenue
Lakewood, CA 90712

Prepared by:

MOFFATT & NICHOL
3780 Kilroy Airport Way, Suite 600
Long Beach, CA 90806
(562) 426-9551

M&N File: 5598

January, 2005

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1.0 INTRODUCTION

Los Cerritos Wetlands is a degraded relic wetland area flanking the lower San Gabriel River. It was formerly a high-quality functioning wetland, but has been isolated from tidal action by construction of flood levees along the River and by development. As a result, the site condition has deteriorated from the 1940's to the present. However, areas of functioning wetland exist with both salt marsh and seasonal ponds. Nearly 45 acres of pristine fully tidal salt marsh exists within the planning area. The goal of local stakeholders is to restore it to a functioning natural condition. Planning may occur at the public level relatively soon to initiate studies for site restoration.

The Los Cerritos wetlands complex is located as shown in Figure 1. As estimated from approximate site boundaries, it roughly includes land owned by Hellman Partners (193 acres), the Bixby Company (193 acres), Ernest Bryant (67 acres) (i.e., the Hellman, Bixby, and Bryant parcels), and the County of Orange (38 acres). A 5-acre parcel referred to as "Los Al" at the northwest end of the Bixby site may be included in the future, for a total project area of 496 acres. An 11–acre corridor extending upstream from the Los Alamitos Retarding Basin toward the Rossmoor Pump station may also be included at some future date. That would increase the area total to approximately 507 acres. Other areas either connected or adjacent to the project area include Gum Grove Park, a future corridor envisioned to connect to the Seal Beach Naval Weapons Reserve crossing Seal Beach Boulevard, and land north of the Los Cerritos channel between Pacific Coast Highway and Loynes Drive.

1.1 Project Objective

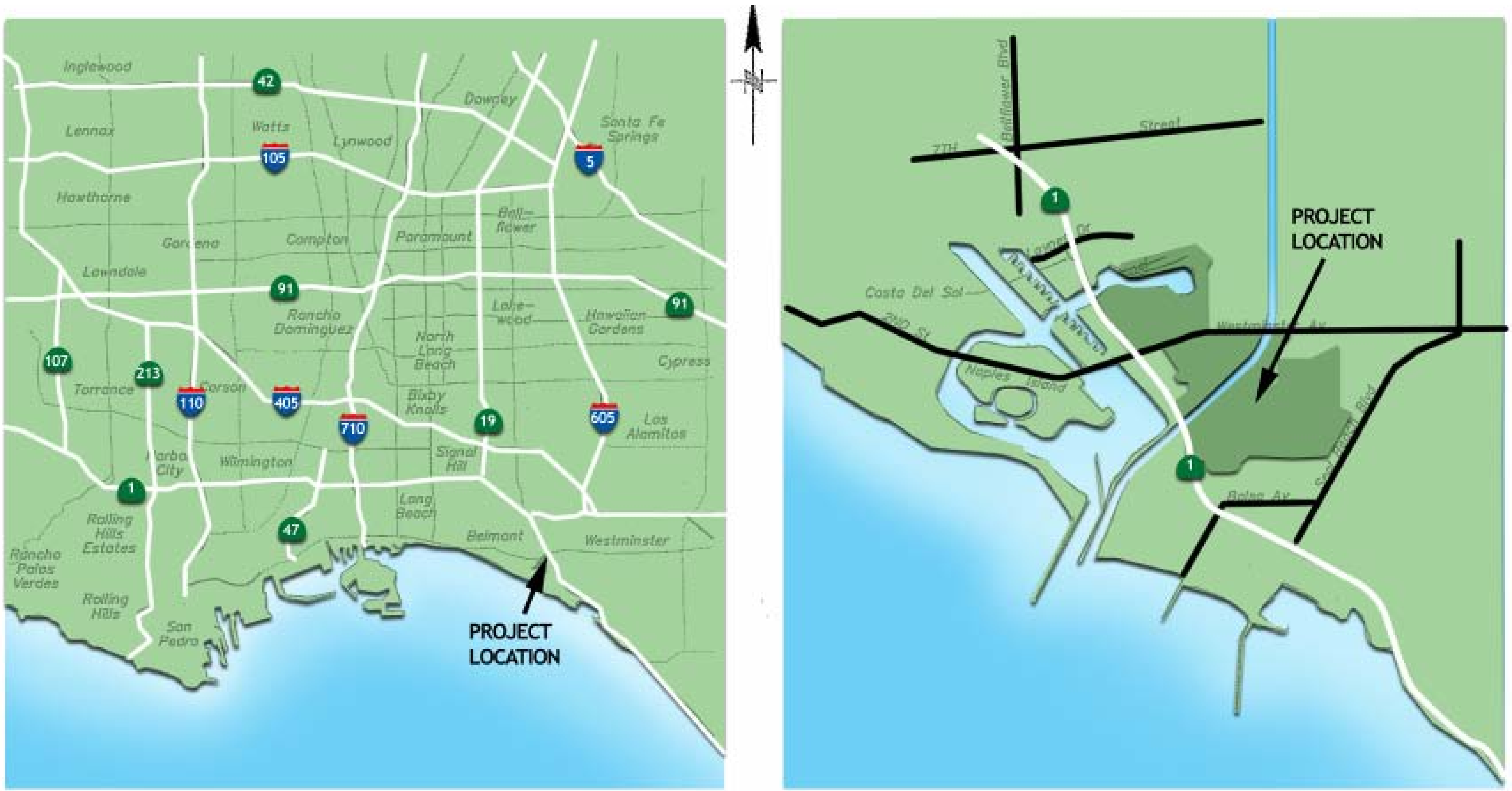
California Earth Corps (CEC) is a local stakeholder group that commissioned preparation of this "White Paper" describing the restoration potential for the Los Cerritos wetlands complex. CEC seeks funding to match existing funds to plan restoration at the wetland with this document serving as a source for informed decisions.

Generally, CEC envisions full tidal flushing, if possible, for the entire wetland complex. Full tidal conditions are to extend inland at least to Westminster Avenue, with future extension north of Westminster Avenue onto the Bixby parcel, as shown in Figure 2. Restoration is to be phased to reflect land availability. Possible phasing to restore the following parcels, assuming they are eventually available for incorporation into this system, is in the order below according to the CEC (as discussed in more detail in this report):

1. Bryant Parcel and the 100-acre deed-restricted portion of the lowland Hellman Parcel;
2. The lower Bixby Parcel and the remainder of the lower Hellman Parcel; and
3. The upper Bixby Parcel and Los Alamitos Retarding Basin (LARB).

The objective of this study is to develop a hydraulic model for full tidal conditions, demonstrating that full tidal restoration is possible and can be accomplished by connecting only to the San Gabriel River as a water source, and not to the Cerritos

Channel. The model must show the range of areas to be inundated at high tides and low tides, and be the basis for habitat planning. All tidal connections must be sufficient, if possible, to convey the future full ocean tide to the parcels. This study is to serve as a starting point for more detailed future studies of restoration at the site.



VICINITY MAP
NTS

LOCATION MAP
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Figure 1 – Project Location

Figure 2 – Land Parcel Ownership at Los Cerritos Wetlands

1.2 Project Background

Wetland restoration has been planned at several of these sites since the 1960's. The sites have mainly been evaluated for restoration on an individual basis, with minimal effort to prepare a comprehensive master plan for restoration on all parcels together. This document is intended to serve as a mini-master plan of restoration for the entire 496-acre site.

The sites were in oil production for the majority of the 20th century. Remnants of oil activity, and/or active oil operations still exist on all parcels except the LARB. The sites have been affected by this land use and contain remnants of this former activity with some areas of contamination. Also, fill was placed over portions of the properties during construction of the San Gabriel River flood control levees and installation of the Haynes Cooling Channel. As a result, the Hellman property and a portion of the Bryant property are higher in elevation than the other sites. Conversely, the site of the LARB was excavated to increase flood retention capacity and thus it lies substantially lower than the other sites. Large portions of the Bryant and Bixby properties lie at their natural elevations with certain exceptions at the locations of oil pads or other infrastructure (certain areas of the Bryant property may have been filled in the distant past, but this requires verification).

None of the sites have been developed, but the LARB serves as a flood retention basin equipped with a pump station owned by the County of Orange. The County operates the pump station and flood retention facility. The pump station consists of several large pumps and outlet works to the San Gabriel River.

Areas adjacent to the Bryant and Bixby Parcels along Westminster Avenue and Studebaker Road historically served as burn dumps. Various types of fill occurred at these sites causing modifications of surface grades and ground settlement in the area. Dumping activities have directly affected the project area along the east boundary of the North Bixby Parcel. Restoration of that site will require remediation of that land. Other parcels contain either active or relic oil extraction infrastructure. This study assumes all site remediation and removal of unneeded infrastructure occurs by others prior to restoration, and therefore the site is essentially “clean and free of obstructions” when restored and no costs or remediation/removal efforts are required for this plan.

1.3 SCOPE OF WORK

The following tasks are included in the contracted scope of work for this report:

1. Combine all existing available topographic files onto one master base map, and overlay onto the City’s aerial photograph.
2. Conceive alternatives or a phased project for full tidal inundation.
3. Prepare a concept-level grading plan, construction staging and construction access areas showing changes in phases.
4. Prepare a one-dimensional hydraulic model of the entire wetland complex for the ultimate Master Plan.
5. Calculate opinions of probable construction costs.
6. Prepare and submit a draft and final report, or White Paper of the findings and all work.
7. Attend meetings.

2.0 DESCRIPTION OF THE CONCEPTUAL RESTORATION PLAN

Restoration of the Los Cerritos Wetlands complex can be accomplished with modifications to existing sites. A connection to reliable and relatively unrestricted seawater sources must occur to support the project. Several approaches to restoration were investigated including restoring the sites by connecting them to the San Gabriel River, the Haynes Cooling Channel, and the Los Cerritos Channel. After considering the advantages and disadvantages of each connection option, it was determined that the optimal connection approach was to connect the Bixby and Bryant sites to the San Gabriel River (SGR), and the Hellman and LARB sites to the Haynes Cooling Channel (HCC). Tidal flooding from the HCC would occur through one-way inflow culverts, and tidal ebbing to the SGR would occur through one-way outflow culverts that pierce the HCC and the SGR levees. The wetland restoration configuration presented herein is referred to as the Estuary Plan.

The intent of the project is to create a condition of hydrology and soils at the sites conducive to development of wetland habitat. Wetland habitat presently exists on portions of the site, but is desired to occupy all appropriate areas, and be complemented by transitional and upland habitat along the perimeter.

Wetland habitat consists of subtidal habitat that is always inundated (below mean lower low water), intertidal habitat that alternates between being inundated and being exposed (between mean lower low water and mean higher high water), and supratidal habitat that is not typically submerged (above mean higher high water). Subtidal habitat is utilized primarily by fish, intertidal habitat is utilized primarily by fish, birds, crabs and worms, and supratidal habitat is primary used by birds and rodents. Intertidal habitat further consists of unvegetated areas called mudflats, and vegetated areas consisting of pickleweed and/or cordgrass stands.

Habitats tend to form around the wetland perimeter at elevations relative to the tides. Typically, unvegetated salt marsh habitats form where inundation occurs greater than 41% of the time, and vegetated habitats evolve at areas where inundation occurs less than 41% of the time. Tidal inundation curves show the percentage of time tides inundate certain elevations within a marsh. The curves can indicate elevations where habitats may form and are included in the tidal analysis in this report.

This project seeks to establish a balance of these habitats on-site in the form of a natural condition. The proportions of the habitats can vary, depending on need within the region, but intertidal habitat is typically considered in greatest need, followed by subtidal habitat, and then supratidal habitat. An example of a proportion of habitats at this site could be roughly 25% as subtidal habitat, 55% as intertidal habitat, and 20% as supratidal habitat.

2.1 Phasing

The Estuary Plan is to be implemented in phases assuming sequential property acquisition. The phasing is assumed to consist of the following:

- Phase I – Restoration of parcels closest to the SGR consisting of sites owned by Bryant (66.9 acres) and the 100-acre deed restricted area at Hellman and the 5-acre parcel along Pacific Coast Highway owned by the State for 171.9 acres. Development is to occur within approximately 5 to 10 years.

- Phase II – Restoration of parcels close to the SGR, and connected to phase I areas and/or the SGR. These parcels consist of the lower Bixby site (44 acres) and the portion of Hellman that is outside of the 100-acre deed restricted area (93 acres) for 137 acres. Development is to occur within approximately 10 to 20 years.

- Phase III – Restoration of the most distant parcels from the SGR. These include the upper Bixby site (139.2 acres) and the LARB (38 acres) for 187.2 acres total. Development is to occur within approximately 20 to 25 years.

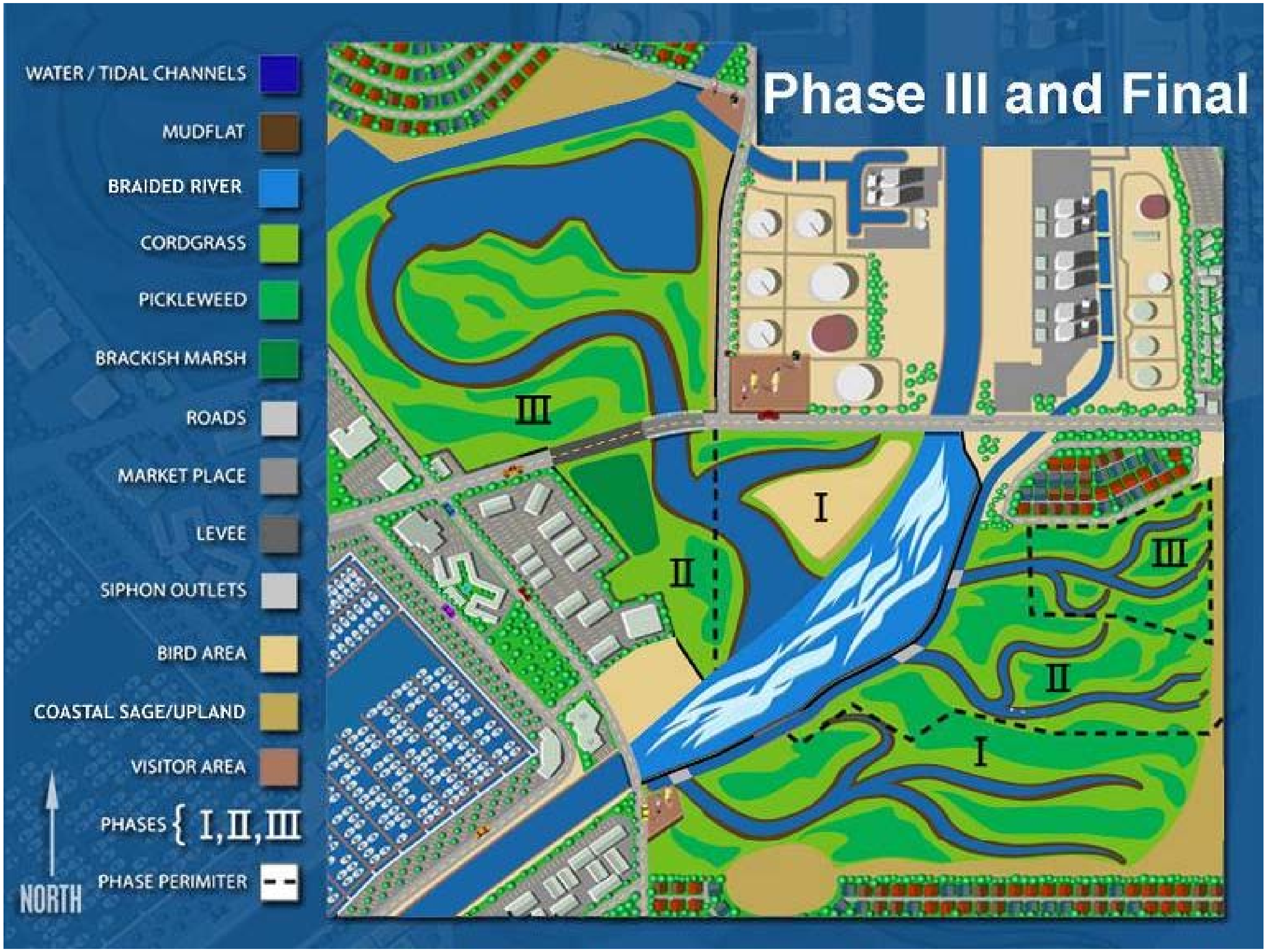
Restoration of this relatively large estuarine area will enable existing fragmented areas and isolated corridors to connect. Approximately 250 acres of potential riparian and upland habitat areas existing within the lower watershed that can interconnect if this project is implemented. Examples are corridors connecting the project site with the SBNWR and the Rossmore Pump Station site, and areas at El Dorado Park, Sims Pond, Channel View Park, and land south of Willow Street adjacent to the San Gabriel River.

The restoration outline presented herein is based assuming willing conveyance of existing land use to wetland/open space, and to be done clean-up by others. Certain landowners may or may not be willing to convert the land use to wetland/open space. Also, restoration assumes adequate removal of existing oil infrastructure and site remediation to be done by landowners prior to restoration. This plan is essentially the hopeful future vision of the CEC. Figures 3, 4 and 5 show phasing of restoration over the site.

Figure 3 – Phase I Restoration Concept

Figure 4 – Phase II Restoration Concept

Figure 5 – Phase III and Final Restoration Concept



2.2 Restoration Approach for Properties West of the San Gabriel River

The Estuary Plan does not include any direct connection of the restored wetland area to the Cerritos Channel, although that channel is closest to the Bixby property. The primary reason the plan does not include connection to the Cerritos Channel is that the channel functions as a one-way draw of seawater into the intake lines of the two power plants located upstream. Currents move water toward the power plants 100% of the time, even during ebbing tides in the channel. The effect of this situation is that eggs, larvae, and juvenile life stages of aquatic species are drawn into the intakes of the power plants with 100% mortality (Bob Hoffman, NOAA Marine Fisheries, and Don May, California Earth Corps, Personal Communication). To avoid the impact to hydraulics from the power plants, it was deemed most appropriate for this study to assume connection of the restored wetland areas to the SGR for tidal exchange, rather than to Cerritos Channel.

Infrastructure modifications are required to implement the alternative as shown in Figures 6, 7 and 8 for each phase, respectively. Specific modifications are discussed in the following sections.

2.2.1 Modifications to Levees

Connecting the Bryant and Bixby properties with the SGR requires either removal or breaching of the west SGR flood levee to provide seawater to the sites. The most unrestricted western tidal connection(s) will occur if the west flood levee is removed. Phase I of the Estuary Plan envisions full removal of the west flood levee from the Westminster Avenue Bridge downstream to approximately 1,100 feet upstream of Pacific Coast Highway (PCH) (phase II includes removal of an additional 400 feet of west levee to a point 700 feet north of PCH).

Removal of the west flood levee will require erection of new levees along the perimeter of the sites to be flooded by seawater and floodwaters. This plan includes perimeter levees along exposed properties during each phase of implementation. Levee placement will vary related to phase boundaries. For example, a levee will be installed initially along the phase I boundary at the west property line of the Bryant property. This levee will be lowered when phase II is constructed, and a new one will be installed along the phase II project boundary. This type of high water management will continue through phase III.

As described in subsequent sections of this report, the east SGR levee will be relocated from its existing footprint to a location along the western bank of the HCC for further estuarine restoration.

Levees are assumed to provide protection from combined high tide and floodwater conditions. As a simplifying assumption, the elevations of the levees are shown to reach the same elevation as the existing SGR levees, or approximately 15 feet above mean sea level. As storm flood modeling is not included in this study, this elevation is assumed to provide the required three feet of freeboard above the combined 100-year design high water level required by the Federal Emergency Management Agency. If this alternative moves forward, further analysis of flooding with levee reconfiguration should eventually occur to confirm or modify this levee elevation.

Figure 6 – Phase I Infrastructure

Figure 7 - Phase II Infrastructure

Figure 8 – Phase III Infrastructure

2.2.2 Channels

Tidal channels will be installed through the restoration area to enable propagation of tidal flows to its upstream end. These channels will require excavation of existing ground to lower the channel footprint sufficiently to convey seawater. One main channel is envisioned to connect the phase I area to the SGR, and to extend upstream into the phase II and phase III areas. Smaller tributary channels will branch off of the main channel and extend toward phase area perimeters to more effectively distribute seawater throughout the wetland. The main channel will be stubbed off at the boundary of phase I and II areas, but placed in a position to be readily connected to subsequent phase areas as they come on-line.

2.2.3 Bridge and Bridge Approaches

A bridge will be required on Westminster Avenue west of the Studebaker Road intersection to allow a channel to connect the Bryant parcel of phase II to the Bixby parcel in phase III. The bridge is envisioned to be a 900-foot-long causeway-type of structure to provide the maximum possible width beneath it for existence of a channel. Surplus channel area is provided under the bridge to enable the channel to meander naturally over time as the wetlands evolve after restoration. The bridge length should be optimized to become shorter, if appropriate, in further analyses to refine any preferred alternative in the future.

The bridge needs to be elevated to prevent flooding during high water, so the roads approaching the bridge also have to be raised. Raising of Westminster Avenue and Studebaker Road is required, as well as their intersection. Existing elevations of the roadways are approximately 5 feet above mean sea level, requiring the elevation to increase by approximately 10 feet to reach the target elevation of 15 feet above mean sea level. A temporary road detour will be required for bridge construction. It is assumed for this study that the detour will lie along the north boundary of Westminster Avenue outside of the roadway right-of-way and into the North Bixby Parcel, thus requiring landowner approval and environmental clearances.

2.3 Restoration of the Properties East of the San Gabriel River

The Hellman and LARB sites to the east of the SGR are conducive to connecting to the Haynes Cooling Channel to supply them with seawater of ambient temperature. Water temperatures in the SGR are elevated from effects of relatively warm water discharge from the upstream power plants. The effect of elevated water temperatures would be to create a monotypic vegetated wetland habitat (assuming that the hydrologic regime is appropriate) that is most tolerant of high temperatures, such as pickleweed (Coastal Resources Management, 1996). To avoid this effect, water could be drawn from the HCC instead, as was concluded to be feasible in a previous study for restoration of Hellman Ranch wetlands (Moffatt & Nichol, 1996). At that time representatives of the Los Angeles Department of Water and Power operating the plant indicated drawing water from the HCC was acceptable if no restrictions were to occur to water supply needs of the plant, and no additional contributions of kelp or other floating debris to the plant would occur (Jose Nalasco, Former Plant Manager, Personal Communication).

Releasing ebbing tidal flow from the wetland into the HCC is considered infeasible according to the previous response from L.A. County personnel. Flap gates will be required on intake culverts at the HCC to prevent outflow of tides to the Channel. Also, ebbing tidal flows from areas east of the SGR could be conveyed directly to the SGR through culverts with one-way flap gates. The flap gates would be installed to prevent tides or stormflows in the SGR from entering the wetland culverts.

This plan envisions that wetland areas east of the SGR could ultimately receive stormflows that are presently discharged into the LARB. The goal is to provide sufficient flood retention area within the wetlands east of the SGR to function equivalent to the planned use of the LARB. Detailed design of the stormflow discharge points and retention areas within the wetlands has not occurred and will eventually be required, but the concept may be feasible and worth future consideration. The larger area of wetland should provide greater flood retention capacity than the existing basin. As a simplifying assumption in this study, pumping and conveyance facilities associated with the pump station are assumed to be entirely removed and not salvageable.

2.3.1 Tidal Connections

One-way culverts (with flap gates to prevent outflow) will be required to connect Hellman Ranch and the LARB to the HCC for flood tidal exchange. They will allow one-way tidal inflow to the wetlands from the Channel, with no tidal outflow into the Channel.

Culverts are also envisioned to connect the Hellman Ranch and the LARB to the SGR for ebbing tidal exchange in each phase (three outflow culverts total). They will allow one-way tidal outflow from the wetlands to the SGR, with no tidal inflow or storm stormflow into the wetlands from the SGR. The culverts would pass through the cross-section of the HCC. Due to the large area of the cross-section of the HCC, it is not anticipated that they would cause any discernible obstruction to flows through the HCC.

2.3.2 Levees

This plan also includes:

- Removing the east San Gabriel River levee and reinstalling it farther east adjacent to the Haynes Cooling Channel; and
- Installation of perimeter levees along exposed property boundaries during each phase of implementation.

The east SGR levee will be relocated from its existing footprint to a location along the western bank of the HCC to further increase the cross-sectional area of the lower SGR and restore estuarine conditions, and to create a braided river channel. Relocating the east SGR levee will further widen the lower SGR cross-section, and increase the area of the estuary at this location. This should favorably modify tidal circulation and stormflow conveyance in the SGR. Tidal circulation will increase as the cross-section expands and more water exchanges in the SGR daily. Stormflows should more effectively be conveyed through the wider cross-section, potentially reducing maximum water surface elevations and flow velocities. The intent of the project is to cause formation of a natural braided river channel at this reach of the SGR.

Removing the east SGR levee will expose the eastern Bryant parcel between the SGR and HCC to direct storm flow erosion. Options to address this condition are to either remove all earthen material at this portion of the Bryant Parcel during construction, or to allow it to passively erode with eventual sediment delivery to the coast. Costs to remove the material could be high due to its large volume. Assuming the material at this portion of the Bryant Parcel is primarily sand, allowing passive erosion of the material as sediment delivery to the coast would be beneficial. For purposes of this study, both options are considered for planning. If passive erosion is concluded to be worthy of further consideration, soils investigation should occur to characterize soil grain sizes at this portion of the Bryant Parcel to assess it suitability for contribution to the coast. It is likely that significant percentages of sand-sized material exist within soils at this site because of its former coastal estuary condition. Also, spoils dredged from construction of the San Gabriel River Channel may have been placed on the site and they would have contained significant sand fractions.

Internal levee placement will occur within the wetlands, and will vary according to phase boundaries. For example, a levee will be constructed initially along the phase I boundary at the north boundary of the portion of Hellman site referred to as the 100-acre lease, the area to be initially cleared of oil production and available for restoration. This levee will be removed when phase II is constructed, and a new levee will be constructed along the phase II project boundary between Hellman land and the LARB. This type of high water management will continue through phase III.

2.3.3 Channels

As with the western restoration area, tidal channels will be constructed through the area to facilitate seawater propagation to the upstream ends of the site. These channels will require excavation of existing ground to lower the channel footprint sufficiently to convey seawater. One main channel is envisioned to connect the phase I area to the SGR, and to extend upstream into the phase II and phase III areas. Smaller tributary channels will branch off of the main channel and extend toward phase area perimeters to more effectively distribute seawater throughout the wetland. The channels are anticipated to be constructed with unprotected side slopes to facilitate natural geomorphic evolution of the channels over time.

2.4 Construction Issues

Construction of infrastructure associated with restoration will be challenging and potentially costly, but technically feasible. Issues are addressed below and illustrated in Figures 9, 10, and 11.

2.4.1 Construction Access

Access to sites during construction is limited to acceptable and available routes leading to the area. Phase I access may be from First Street in Seal Beach to the Hellman site, and from Westminster Avenue into the Bryant site at two points. Phase II access is also from Westminster Avenue into the lower Bixby site, and from Westminster Avenue into the Hellman site behind the LARB. Phase III access is mainly from major roads such as Studebaker Road and Westminster Avenue into Upper Bixby, and from Westminster Avenue to the LARB.

2.4.2 Construction Staging

Construction staging of equipment and materials is also a necessity and each phase offers some area for this use. Phase I staging can occur at the Bryant site east of the SGR. Phase II staging can occur at the lot near the intersection of Studebaker Road and Westminster Avenue, and within or behind the LARB, and phase III staging can occur along the eastern edge of Upper Bixby and behind the LARB. It is suggested that construction activities be planned to utilize land and accessways already owned by project proponents or owners.

A significant reduction in project costs could occur if soils excavated during phases I and II could be stockpiled near to the LARB and/or the intersection of Studebaker Road and Westminster Avenue to enable reuse of the material as part of phase III fills. Figure 10 shows an example staging area for soils along the southern LARB boundary for this purpose. Habitat area would be occupied by such as staging area and this would have to be considered for project planning and approvals.

Figure 9 – Phase I Construction Access and Staging Areas

Figure 10 – Phase II Construction Access and Staging Areas

Figure 11 – Phase III Construction Access and Staging Areas

3.0 ANALYSES OF THE RESTORATION ALTERNATIVE

Tidal hydrology of the restoration alternatives was analyzed using available data and a one-dimensional numerical link-node model. The numerical model was used as a tool to quantitatively predict conditions after restoration. All wetland areas associated with each of the alternatives were modeled to quantify tidal hydrology.

Tidal conditions are important for the wetlands because they dictate the daily hydrologic conditions of:

- Circulation and flushing that depend on parameters of tide range and lags, and tidal prism – the affected properties are rate of water residence time and water quality; and
- Inundation conditions and frequency that depend on parameters of tidal elevations over time (expressed as inundation curves) and tide lags – the affected properties are habitat distributions.

As such, the analyses herein focus primarily on tide range, elevations, time lags, tidal prism, residence time, and inundation frequencies. A one-dimensional (link-node) numerical model was developed to quantify restored tidal hydrologic conditions. The hydraulic system is simulated by representating the system as a series of channels (links) and storage basins (nodes). Water levels in the storage basins and flow velocities in the channels that connect the basins are computed in the simulation. The water levels in the basins and the flow velocities in the channels are related through conservation of mass and conservation of momentum. The purpose of this effort is to perform an order-of-magnitude analysis to identify the feasibility of the restoration alternative for decision-making.

3.1 Existing Tide Conditions

Based on the previous study (M&N 1996), the tides in the SGR and HCC under dry weather conditions are closely approximated by the ocean tides measured at the Los Angeles Outer Harbor tide gage shown in Table 1. In order to compute typical wetland tidal behavior, an artificial two-week tidal sequence called Tidal Epoch Analysis (TEA) tide was used. This synthetic tide series has the same statistical mix of tide heights as the Los Angeles station. The driving tide is shown in Figure 12. The average spring high and low tides are +4.0 and -4.2 feet above mean sea level, respectively. Processes of tidal circulation, flushing, and inundation frequencies within the wetlands are dictated by the tides. Although not calculated, seawater residence times are all likely to be shorter than one week based on experience with other similar projects. This timeframe is indicated as the desired threshold for restoration for other similar sites (Wetlands Research Associates, 1995).

Table 1. Recorded Water Levels at Los Angeles Outer Harbor

	Datum (ft, MLLW)	Datum (ft, MSL)
Extreme High Water (1/27/1983)	7.96	5.16
Mean Higher High Water (MHHW)	5.52	2.72
Mean High Water (MHW)	4.77	1.97
Mean Sea Level (MSL)	2.8	0.0
Mean Low Water (MLW)	0.95	-1.85
Mean Lower Low Water (MLLW)	0.0	-2.8
Extreme Low Water (12/17/1933)	-2.59	-5.39

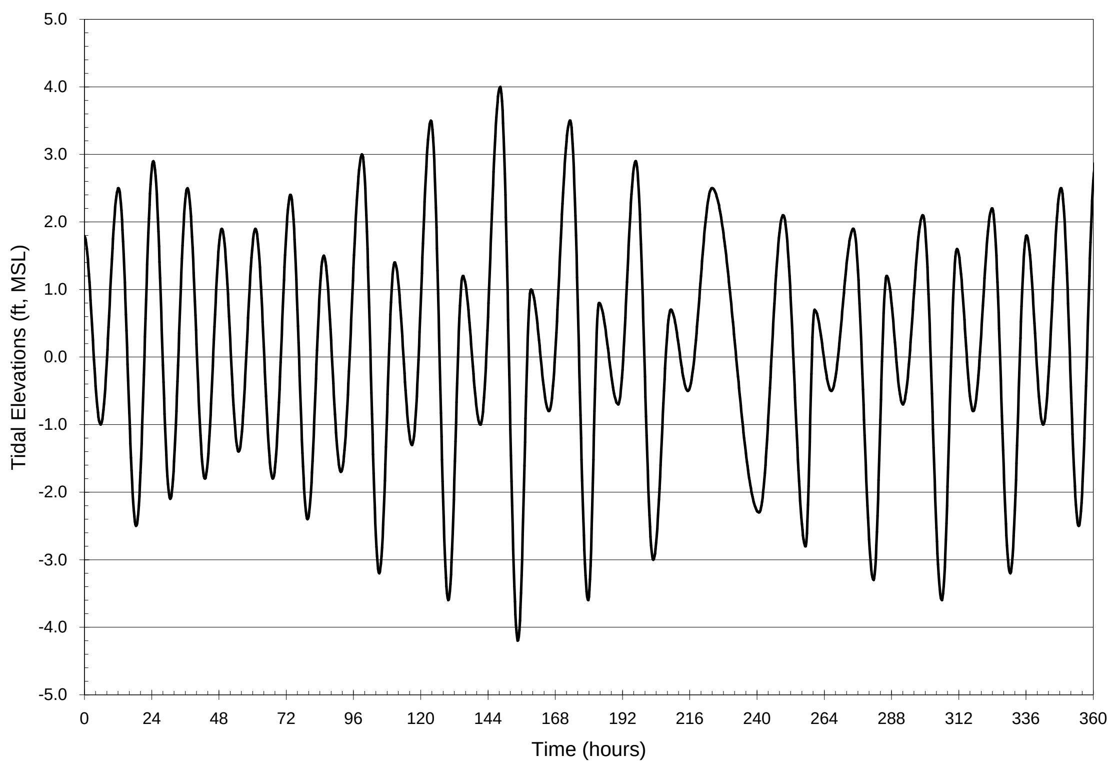


Figure 12 - Model TEA Tidal Series

Under existing conditions no tidal conveyance occurs to the Bryant, lower Bixby, and LARB parcels. Limited tidal conveyance occurs at Hellman Ranch, and relatively unrestricted tidal conveyance occurs at the Steam Shovel Slough on the upper Bixby parcel.

3.2 Tide Conditions in Restored Wetlands

3.2.1 Phase I

Figure 13 graphically shows water surface elevations during spring tidal conditions, and lags of high and low tides in time, compared to the ocean for all parcels in a phase I restored condition. Table 2 shows each tidal parameter. Generally, the tides are attenuated at Hellman Ranch by the culvert connections to the SGR. The effect of tidal attenuation is not detrimental to restoration at this site as it lies at an elevation well above mean sea level and needs to be significantly lowered anyway. The muting reduces the extent of site lowering required for restoration. The Bryant property will experience a full tide range. Both sites will possess a tidal prism that is sufficient to generate fairly frequent tidal flushing and exchange.

Both phase I sites will fill and drain sufficiently for wetland restoration and habitat establishment to occur based on tidal inundation frequency curves prepared for each marsh shown in Figure 14. Unvegetated wetland areas will form at elevations below 0.5 feet above mean sea level, and vegetated marsh will form above that elevation up to 4 feet above mean sea level. Residence times are likely to be shorter than one week in the judgement of the engineer based on other similar projects.

Table 2. Tidal Conditions for Phase I

Locations	Tidal Range (Feet, MSL)	Tidal Prism (Acre-Feet)
San Gabriel River/Haynes Channel	-4.2 to 4.0	Not Applicable
Hellman Ranch	-2.3 to 4.0	48.0
Bryant Parcel	-2.7 to 4.0	90.0

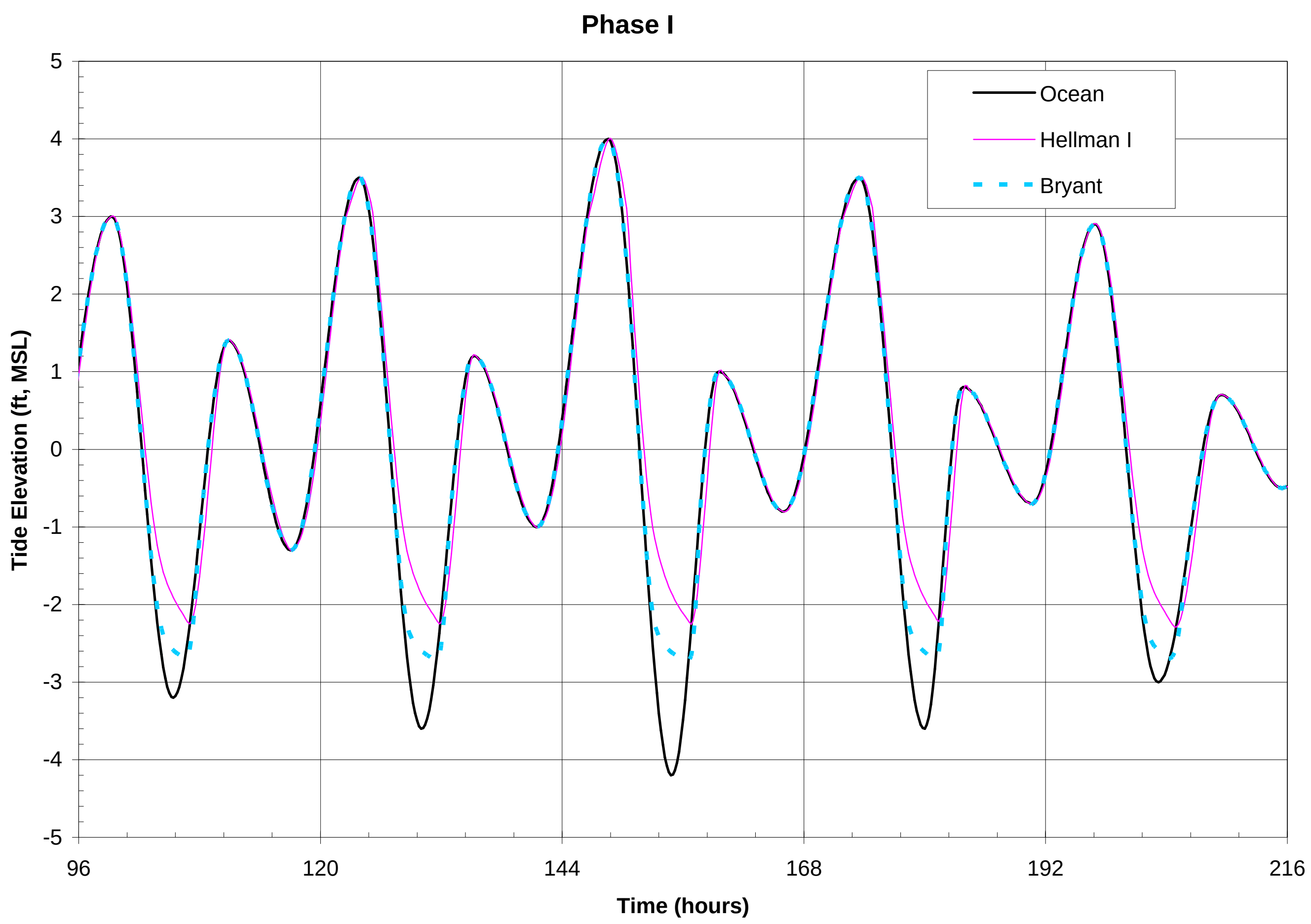


Figure 13 – Phase I Tidal Fluctuations Under Spring Tide Conditions

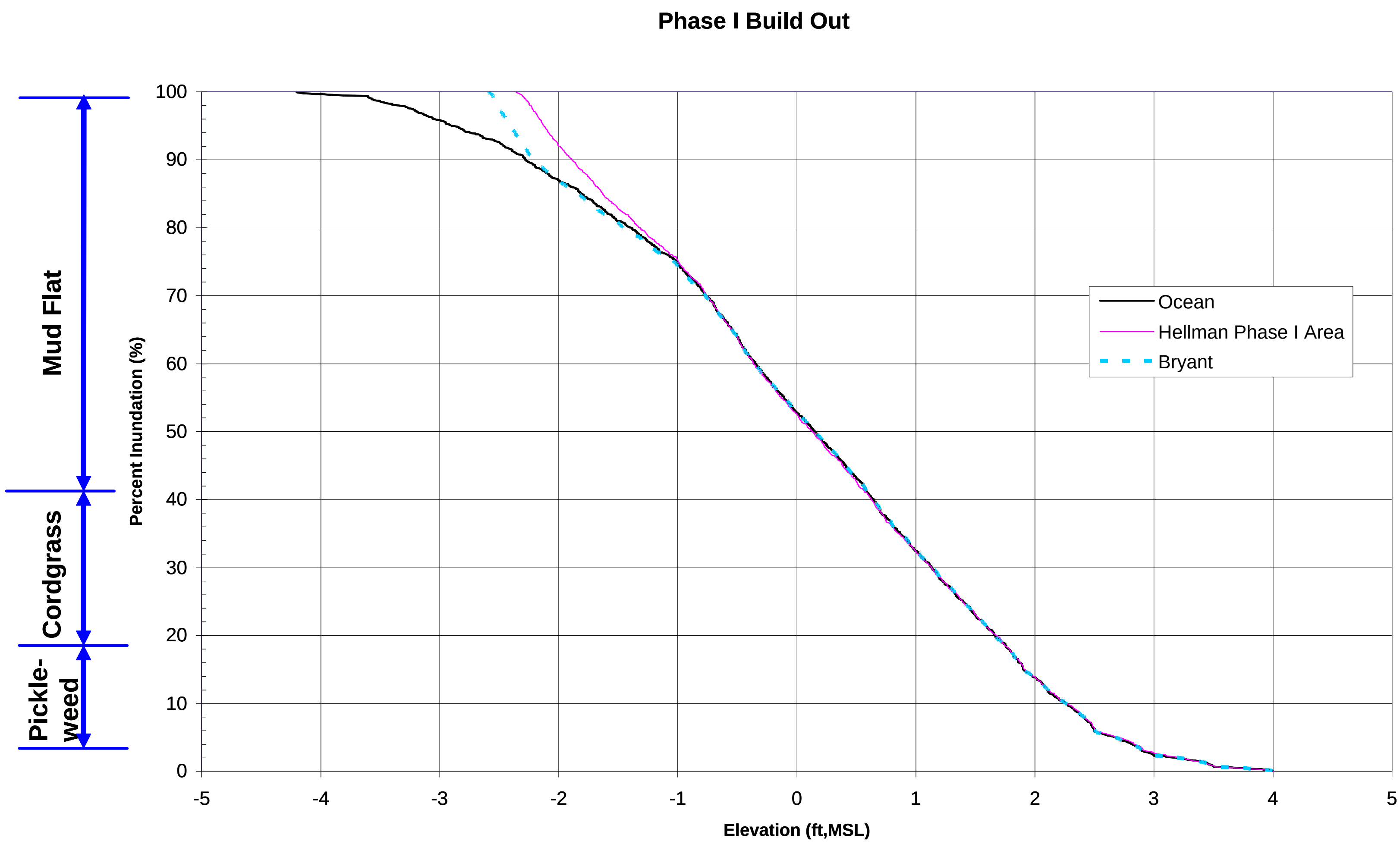


Figure 14 - Phase I Inundation Frequency Curves

3.2.2 Phase II

Figure 15 graphically shows water surface elevations during spring tidal conditions, and lags of high and low tides in time, compared to the ocean for all parcels in a phase II restored condition. Table 3 shows each tidal parameter. The tides are still attenuated at Hellman Ranch by the culvert connections to the SGR. As stated previously, the effect of tidal attenuation is not detrimental to restoration at this site as it lies at a relatively high elevation relative to tides and must be significantly lowered. The muting reduces the extent of site lowering required for restoration. The lower Bixby property will experience a full tide range. Both sites will possess a tidal prism that is sufficient to generate fairly frequent tidal flushing and exchange.

Phase II sites will fill and drain sufficiently for wetland restoration and habitat establishment to occur based on tidal inundation frequency curves prepared for each marsh shown in Figure 16. Unvegetated wetland areas will form at elevations below 0.5 feet above mean sea level, and vegetated marsh will form above that elevation up to 4 feet above mean sea level. Residence times are likely to be shorter than one week, based on the tidal predictions and engineer's judgement.

Table 3. Tidal Conditions for Phase II

Locations	Tidal Range (Feet, MSL)	Tidal Prism (Acre-Feet)
San Gabriel River/Haynes Channel	-4.2 to 4.0	Not Applicable
Hellman Ranch Phase I Area	-2.3 to 4.0	48.0
Hellman Ranch Phase II Area	-2.6 to 4.0	29.5
Lower Bixby Parcel	-2.6 to 4.0	45.5
Bryant Parcel	-2.6 to 4.0	88.0

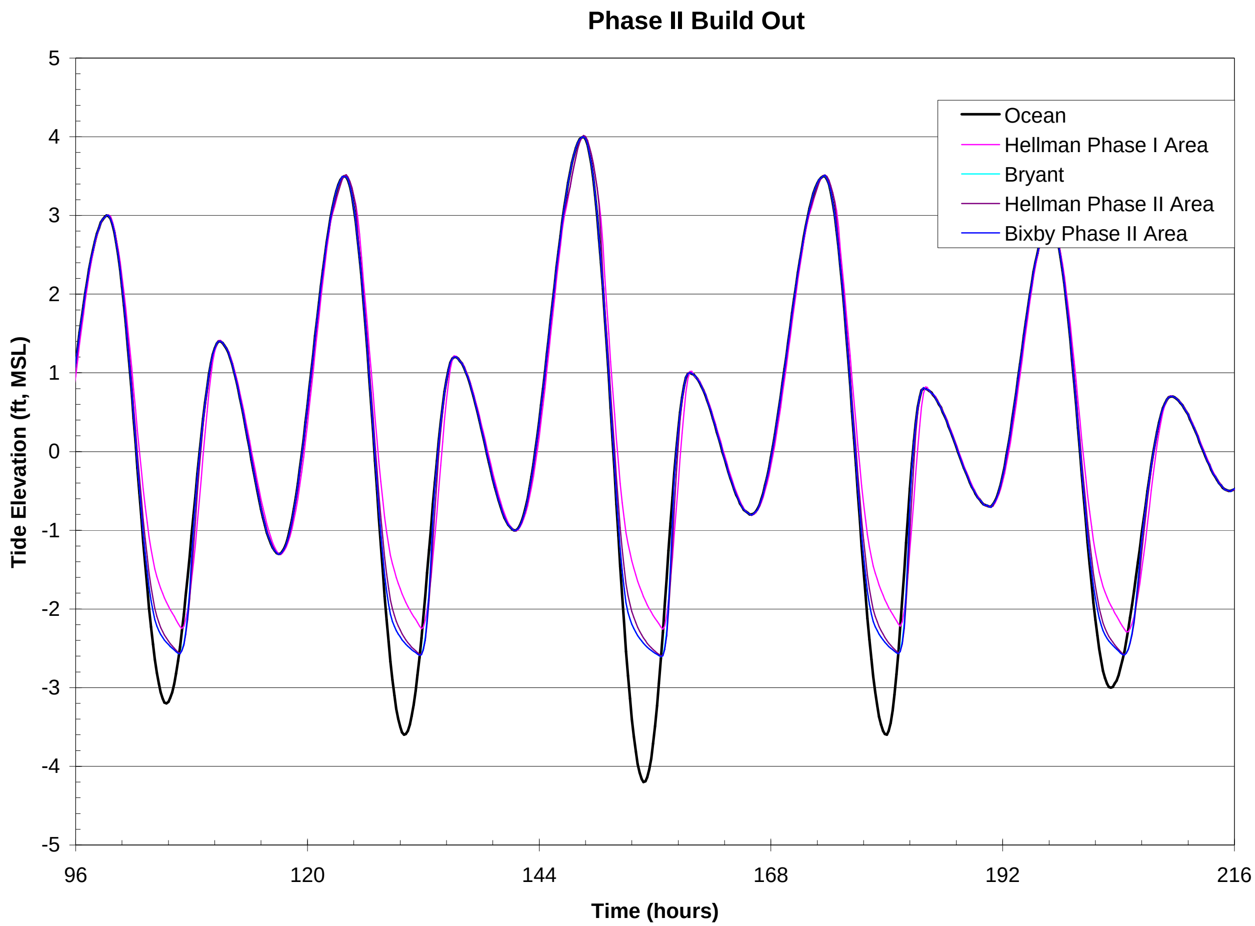


Figure 15 - Phase II Tidal Fluctuations Under Spring Tide Conditions

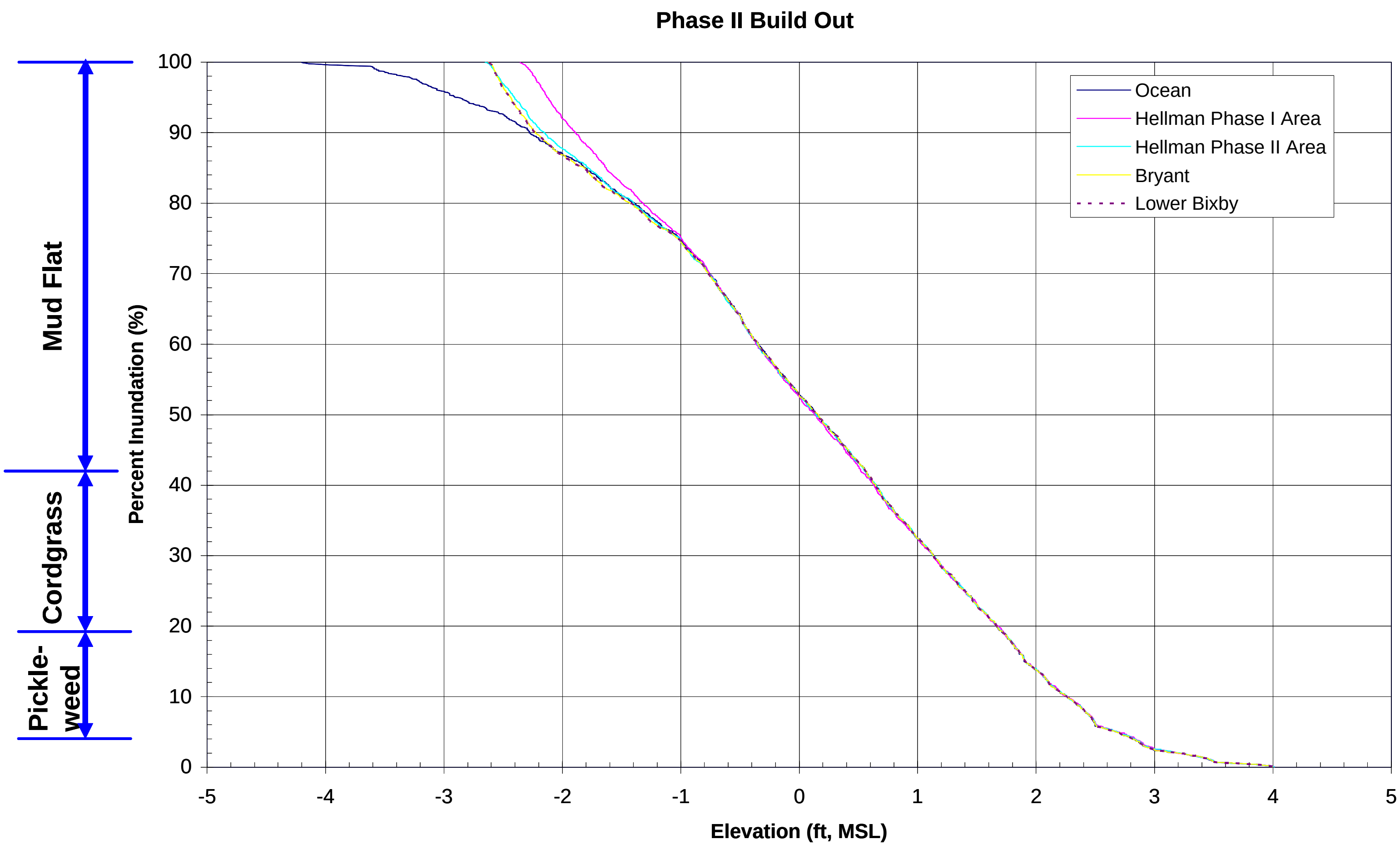


Figure 16 - Phase II Inundation Frequency Curves

3.2.3 Phase III

Figure 17 graphically shows water surface elevations during spring tidal conditions, and lags of high and low tides in time, compared to the ocean for all parcels in a phase III restored condition. Table 4 shows each tidal parameter quantitatively. The tides are attenuated at LARB by the culvert connections to the SGR, but the effect of tidal attenuation is not detrimental to restoration as discussed above. The Bryant and Bixby properties will experience a full tide range. All sites will possess a tidal prism that is sufficient to generate fairly frequent tidal flushing and exchange.

Phase III sites will fill and drain sufficiently for wetland restoration and habitat establishment to occur based on tidal inundation frequency curves prepared for each marsh shown in Figure 18. Unvegetated wetland areas will form at elevations below 0.5 feet above mean sea level, and vegetated marsh will form above that elevation up to 4 feet above mean sea level. Residence times are likely to be shorter than one week, based on the tidal predictions and engineer's judgement.

Table 4. Tidal Conditions for Phase III

Locations	Tidal Range (Feet, MSL)	Tidal Prism (Acre-Feet)
San Gabriel River/Haynes Channel	-4.2 – 4.0	Not Applicable
Hellman Ranch Phase I Area	-2.3 – 4.0	48.0
Hellman Ranch Phase II Area	-2.6 – 4.0	29.5
Lower Bixby Parcel	-2.3 – 4.0	44.3
Upper Bixby Parcel	-2.2 – 4.0	274.0
LARB Parcel	-2.3 – 4.0	32.6
Bryant Parcel	-2.2 – 4.0	84.0

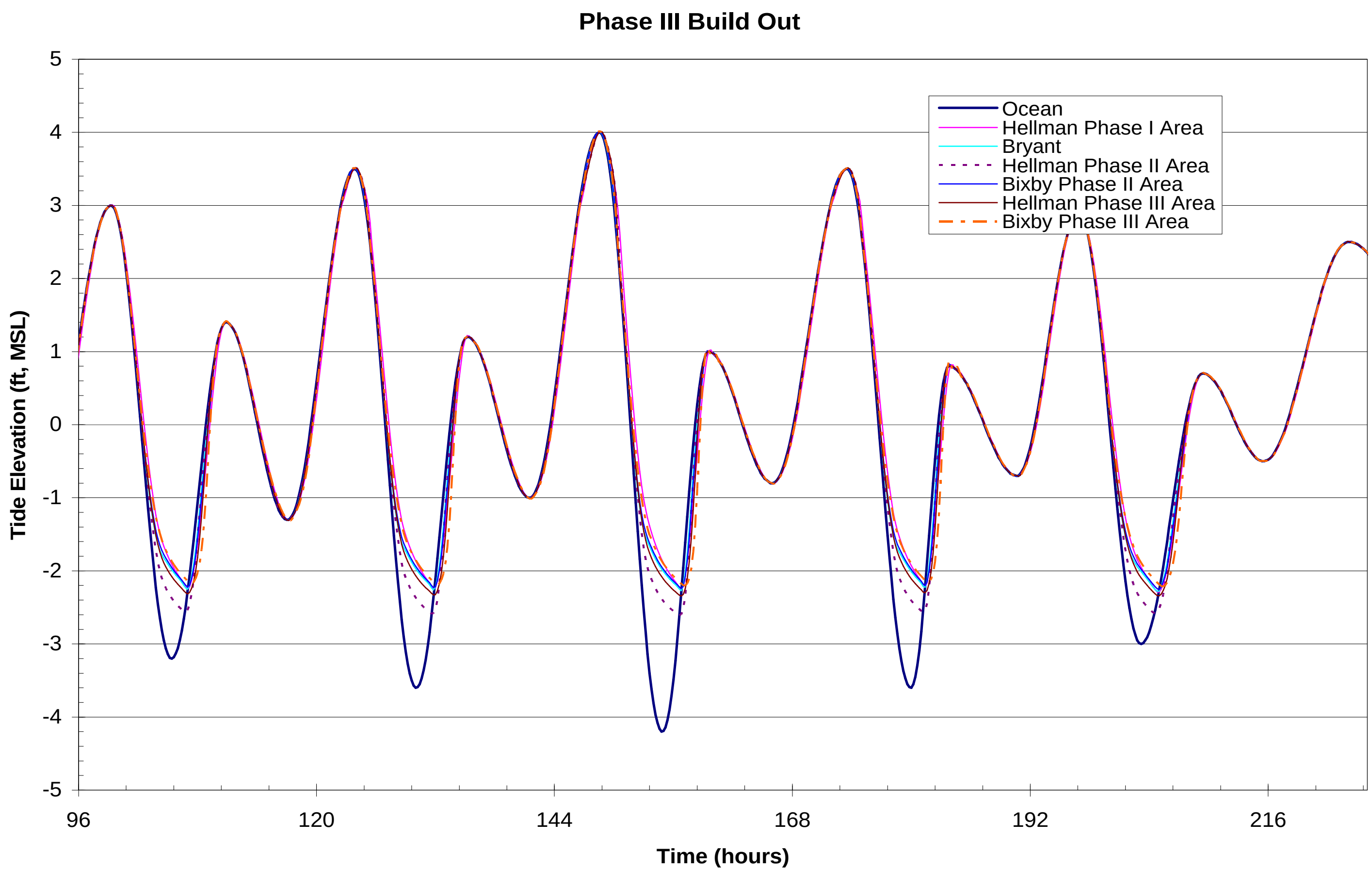


Figure 17 - Phase III Tidal Fluctuations Under Spring Tide Conditions

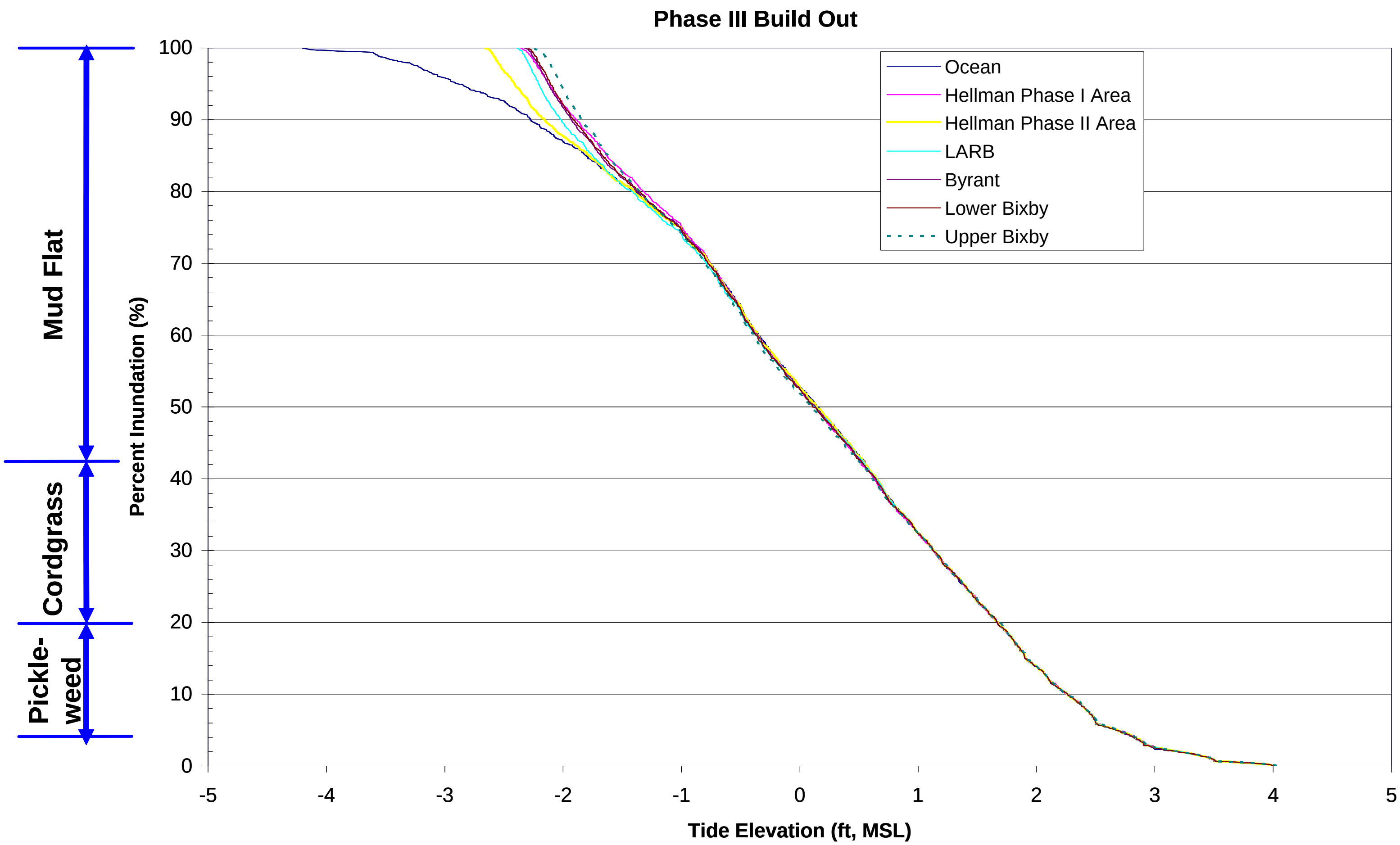


Figure 18 - Phase III Inundation Frequency Curve

4.0 Opinions of Probable Construction Costs

Construction costs for each phase were estimated and are provided in the appendix. Table 5 below shows the total cost for each project phase. Spreadsheets in the appendix show the itemized breakdown of the costs, and the assumptions applied. The total costs conservatively assume all surplus earth material is trucked to local landfills as uncontaminated disposal. Costs for all phases include allowances for design, engineering, environmental review, and permitting in each spreadsheet.

Costs to restore the marshes, assuming all high-end items were installed, would range from approximately $9 million to $39 million per phase, with the total cost approximately $76 million for all areas together. The greatest cost components are disposal of surplus soils from excavation, and installation of the bridge/causeway. These components comprise between 30 and 50% of the costs, indicating that significant cost-reduction benefits can be gained by addressing these components in more detail as part of the preliminary design.

For example, soil stockpiling should be considered on-site between phases I and III to provide the needed fill soils in the last phase and reducing disposal costs in earlier phases. Cost reductions could be as much as $15 million total from this effort. Also, an option to upland disposal may include placement at the Port of Long Beach by barge if Port development occurs in a timeframe coincident to material production. This opportunity needs to be verified. Finally, bridge costs could be reduced by $6 million or more if the bridge were shortened to 500-feet-long rather than nearly 1,000-feet-long as envisioned herein. Hydraulic conveyance infrastructure other than a bridge, such as box culverts under Westminster Avenue, could also be considered to possibly reduce costs.

Table 5. Opinion of Probable Construction Costs for Each Phase

PHASE	CONSTRUCTION COST
PHASE I	$28,500,000
PHASE II	$8,600,000
PHASE III	$38,600,000
TOTAL COST	**$75,700,000**

5.0 CONCLUSIONS

This restoration study of the Los Cerritos Wetlands complex addresses the feasibility of restoration and presents a phased concept for use in decision-making. Analyses are performed at a cursory level to provide preliminary direction to restoration. Initial analysis of a phase alternative is presented with order-of-magnitude estimates. Results indicate the following:

1. A project could be implemented and centered on the San Gabriel River as the estuary to feed adjacent marshes. Sufficient tidal exchange could occur within the wetlands from seawater conveyed from the San Gabriel River and the Haynes Cooling Channel.

2. Two restoration approaches are suggested for consideration including:

    a. Restoring the area west of the San Gabriel River by removing the west river levee and allowing free-flow of seawater and stormflows upstream; and
    b. Restoring the area east of the River by connecting parcels to the Haynes Cooling Channel for tidal inflows, and to the River for tidal outflows.

3. Essentially full tidal conditions can be realized at each parcel with a sufficient connection. With such tidal conditions, tidal residence times will be relatively short and tidal flushing will be frequent, thus maintaining desirable water quality.

4. Construction will require coordination of access routes and staging areas. Such opportunities appear to exist at the sites throughout the restoration period assumed for phasing.

5. Significant costs will be incurred from installing infrastructure needed to accommodate the project, although savings could be realized either by stockpiling surplus soils from early phases on-site for use in the last phase, or moving the last phase up in time to occur earlier in the process.

6. Additional studies should occur for stormflows in the San Gabriel River to identify reductions in the water surface elevation from expansion of the San Gabriel River Channel cross-section by this plan, and to confirm the elevation required for the phase III bridge. The results could bear on levee requirements and project costs.

7. Soils investigation should occur at the portion of the Bryant Parcel between the San Gabriel River and Haynes Cooling Channel to characterize soil grain sizes to assess it suitability for contribution to the coast.

8. Verification of the potential for the Port of Long Beach to receive surplus earth material should occur.

REFERENCES

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APPENDIX

CONSTRUCTION COST ESTIMATES

CONSTRUCTION COST ESTIMATE
SUMMARY
LOS CERRITOS WETLANDS RESTORATION CONCEPT PLAN

Phase	Parcel	COST
I	Bryant	$17,501,000
	Hellman	$10,965,000
	TOTAL:	$28,466,000
II	Hellman Phase II	$6,301,000
	Lower Bixby	$2,309,000
	TOTAL:	$8,610,000
III	Upper Bixby	$34,049,000
	LARB	$4,535,000
	TOTAL:	$38,584,000
	GRAND TOTAL	$75,660,000